



NASA STTR 2012 Phase I Solicitation

T10 Nanotechnology

Nanotechnology, addresses four subareas: engineered materials and structures, energy generation and storage, propulsion, and sensors, electronics, and devices. Nanotechnology describes the manipulation of matter and forces at the atomic and molecular levels and includes materials or devices that possess at least one dimension within a size range of 1-100nm. At this scale, quantum mechanical forces become important in that the properties of nano-sized materials or devices can be substantially different than the properties of the same material at the macro scale. Nanotechnology can provide great enhancement in properties, and materials engineered at the nano-scale will shift the paradigm in space exploration, sensors, propulsion, and overall systems design.

Subtopics

T10.01 Innovative Refractory Materials for Rocket Propulsion Testing

Lead Center: SSC

Participating Center(s): KSC

NASA has identified the advancement of materials as a critical technological need in supporting future space flight and rocket test operations. Specifically, innovative materials for thermal management applications have been targeted with the additional goal of furthering nanotechnology. With the development of these new multi-functional, high-temperature materials comes the requirement for verification and validation of the predictability of their thermal behavior.

The current subtopic is to develop innovative refractory materials which use nano-particle additives and/or unconventional non-cement based refractories that can withstand the extreme plume heating environments experienced during rocket propulsion testing. The material should provide a revolutionary improvement over conventional castable refractories. Explicitly, the nano-based or multi-functional material should provide substantial improvements in several of the following areas:

- Compressive and flexural strength.
- Thermal, abrasion and corrosion resistance.

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- Operating temperatures at or above 4000 °F.
 - Excellent workability for potential lining of vertical walls/pipes.
 - Ultra-low porosity.

Demonstration of the performance of these materials in environments similar to rocket plume environments will be a critical aspect of the success and usefulness of the proposed technology. In addition, verification and validation of the predictability of the material behavior during ablative heating is of high importance to the mission of NASA.

Other potential applications of nano-particle/multi-functional refractory materials might be use in expendable (or even reusable) rocket engine thrust chambers, control system thrusters, and nozzles to extend the life of the testing infrastructure and components. These engine components could be for launch or in-space propulsion systems. This application would add a requirement to be light weight and provide manufacturability for use in coatings or production of components.